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LENDING STRUCTURE AND MARKET RISK EXPOSURES: THE MALAYSIAN CASE

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ABSTRACT

This study addresses the linkages between lending structure and market risk exposure. The influence of lending structure is analysed by four measures: the real estate lending, the specialisation index, the short-term lending stability, and the medium-term lending stability. Our findings show that lending structure to some extent affects the market risk exposure to some extend. At the same time, listed bank holding companies showed higher levels of market risk during and after the 1997 Asian financial crisis. Meanwhile, the desired effect of bank mergers in terms of reducing market risk exposure did not materialise in this study. Thus, the findings of this study posits at least two implications; (1) policy makers should react accordingly in the decision-making process towards achieving the expected result of the monetary policy transmission mechanism, and (2) banks and investors should account the impact of lending structures in addition to the significance effect of loan expansion and management efficiency when determining market risk exposure of bank holding companies.

Keywords: lending structure, market risk, commercial banks

INTRODUCTION

Market risk is a subject that has received much attention in the banking literature. Indeed, the ongoing global financial crisis has heightened intention in this particular subject. While prior studies show an increase in loan growth increases market risk, the structure of loan portfolio also play a vital role. Strategising lending structure has become popular since Hanson, Pesaran and Schuermann (2008) proved theoretically that risk might be diversified if bank lending goes to different sectors, even in cases of a sufficiently large portfolios. Marcucci and Quagliariello (2009) also found that varying levels of portfolio riskiness has different effect during various phases of the economic cycles. They show that expansion efforts of riskier banks (due to high credit risk) are four times more affected during recessions than less-risky banks. Riskier banks are also three times more affected by the impact of economic conditions during recession than less-risky banks. This implies that strategising bank portfolios is crucial, particular when structuring lending, because it has a different impact on bank risk

exposure in different economic cycles. Besides risk exposure, Rossi, Schwaiger and Winkler (2009) also found that different lending structure affect bank efficiency and capitalisation. Further, Blasko and Sinkey Jr. (2006) showed that concentration in real estate lending can challenge the ability of the US banks to manage interest rate risk. In the Malaysian context, Ahmad and Ariff (2004) found that lending to risky sectors is negatively related to the market risk exposure of depository institutions. However, Madura, Martin, and Taylor (1994) showed inconsistent results between the depositories and banking institutions. Therefore, this study aims to investigate the relationship between lending structure and market risk in the case of commercial banks. Prior research has primarly addressed either the real estate lending or lending specialisation. This study incorporates the stability factor of lending structure in both short- and medium-term, in addition to these two normative measures. To the best of the authors' knowledge, this study is the first attempt to investigate the stability effect of lending structure. The stability models are adopted from Ibrahim and Amin (2004), Amin and Ferrantino (1997; 1999) who study the impact of export structures on the economic growth. Against this background, the novelty of this study can be addressed in at least three ways, by focusing on: (i) market risk exposure developed from three-factor Capital Asset Pricing Model (CAPM), (ii) lending structure measures (real estate lending, specialisation index, short- and medium-term lending structure stability) and (iii) commercial banks in a developing country like Malaysia.

This paper is divided into six sections including the introduction. Section 2 describes the lending behaviour of the commercial banks in Malaysia for the study period. Section 3 outlines a literature review, and Section 4 highlights the data and methodology. Section 5 that presents the empirical findings, and finally Section 6 concludes the study.

LENDING BEHAVIOUR IN MALAYSIA

Figure 1 shows the trend of lending behaviour for the commercial banks in Malaysia. In real estate lending [Figure 1(a)], there is an upward sloping trend, particularly after 1995. Expansionary monetary policy and continuous improvement of the economy have attracted large capital inflow and direct foreign investments into the country. This economic phenomenon was the basis for the strong and sound banking system in 1996, so it was not surprising that the demand for real estate lending skyrocketed from 1995 to 1996. This demand maintained an upward trend with steady growth, except for a hiccup from 2003 to 2005. Nonetheless, the growth of real estate lending is not risk-free. In June 2009, the monthly aggregate data for the Malaysian commercial banks showed that the highest non-performing loan (NPL) came from the real estate lending, at around

45.66% (NPL for real estate lending is RM14.8 million out of total NPL RM32.4 million) (*BNM Statistical Bulletin*, August 2009). For the short-run lending stability [Figure 1(b)], the overall short-run lending composition ranges from 0.72 to 0.92, inferring that the Malaysian lending portfolio is rather stable. The low lending composition change (LCC) value in 2005 is due to changes in reporting style. Instead of categorising the loan by sectors, loans are now categorised by economic purpose.[1] For the specialisation index [Figure 1(c)], the dramatic drop from 1994 to 1996 shows that banks had a more specialised initial lending strategy, but tended to diversify after 1996 before reverting to specialised lending in 2004. Finally, Figure 1(d) demonstrates the variance of the traditionality index across sectors, based on five-year intervals. Variance of traditionally (VART) is employed to investigate the stability of the lending composition in the medium-term. Data from 1996 to 2003 shows a divergent lending structure pattern. This indicates that banks are remaining flexible when reacting against their risk-return profile and customers' demands as a strategy in maintain a sound banking system through periods of financial crisis.

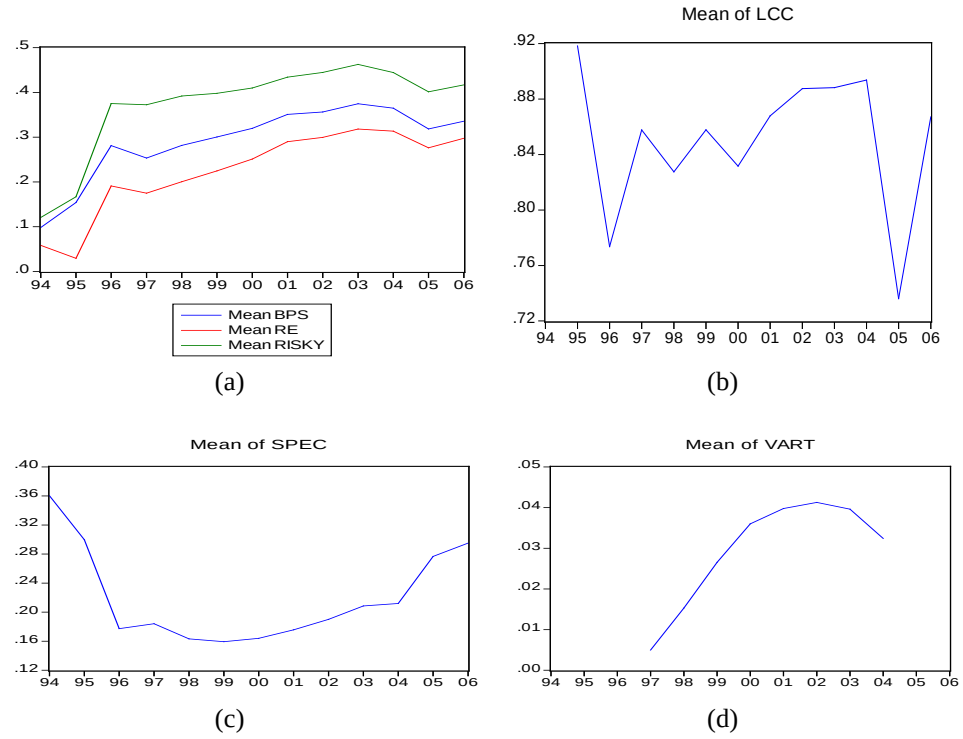

Figure 1. Trends of lending structure: (a) share of broad property sector, lending real estate and risky sectors to total lending, (b) change in lending composition (LCC), (c) specialisation of lending (SPEC), and (d) variance of traditionality index (VART).

LITERATURE REVIEW

Studies on the determinants of bank risk exposures *per se* are very limited. So far, only Madura et al. (1994) and Ahmad and Ariff (2003) had explicitly examined the factors affecting the risk exposure of financial institutions. For the former, Madura et al. (1994) researched the determinants of the ex-ante risk for the deposit-taking institutions and commercial banks in the US.[2] Their findings showed that depository institutions and commercial banks have different determinants, inferring that each entity should be studied separately.[3] For the later, Ahmad and Ariff (2003) investigated the determinants of the CAPM risk measures using the single-factor CAPM approach. Unlike Madura et al. (1994), they only focused on the Malaysian deposit-taking institutions.[4] They analyse 14 bank-specific variables (BSV) on equity risk, market risk, total risk and unsystematic risk exposure.[5] Their findings show that each type of risk exposures has different risk determinant.[6]

As the theoretical framework for risk exposure is not yet established, most studies include the BSV when investigating a specific risk-related issue. Saunders, Strock, and Travlos (1990) incorporated three BSV when studying ownership structures of the US banking institutions: financial leverage, operating leverage, and size. They found that BSV affect seven types of risk exposure differently. In another ownership study, Anderson and Fraser (2000) applied an additional BSV of *frequency*. They believed that *frequency* (defined as the ratio of an average daily share volume traded to number of outstanding shares) could represent the level of business risk exposure since it denoted the speed at which new info is captured in stock prices and correlated to variances in bank balance sheets and off-balance sheet portfolios. Their findings showed that size is negatively related to total risk, but positively related to market risk. Meanwhile, *frequency* is positively related to total and market risks. While Saunders et al. (1990) and Anderson and Fraser (2000) analysed US banks, Konishi and Yasuda (2004) examined the same issues for Japanese banks. They found that size and capital buffer are negatively related market risk exposure. For Spanish banks, Marco and Fernandez (2008) employed three BSV (size, profitability and type of business). Studying bank governance across many countries, Laeven and Levine (2009) and Angkinand and Wihlborg (2009) incorporated both BSV and country-specific variables (CSV) as control variables. Depending on the countries involved, they included CSV such as per capita income, rights, capital requirements, capital stringency, restrict, deposit insurance, enforcement of contracts, merger and acquisition, and Gross Domestic Product (GDP) volatility. The BSV employed were size, credit quality, capital buffer, and liquidity ratio). Since this study focuses on Malaysia, CSV will be ignored. Taken together, studies on ownership structure for a single country show that BSV include size, credit quality, liquidity ratio, and capital buffer.

Focusing on loan sales and risk, Hassan (1993) incorporated six BSV that comprise credit, interest rate, and business variables.[7] Based on five market risk measures, he found that lending specialisation and loan expansion are positively related to all types of market risk measures.[8] Unlike Hassan (1993), Cebenoyan and Strahan (2004) applied four BSV that consisted of capital, liquidity, and credit variables.[9] Analysing four accounting risk measures, he found all BSV to be significant.[10] Capital and liquidity variables are inversely related to risk, and vice versa for credit variables. Examining the impact of derivative activities on the interest rates and exchange rate risks of Asian-Pacific banks, Yong, Faff, and Chalmers (2009) employed seven BSV reflecting business, capital, liquidity, interest rate, and credit related variables.[11] In sum, studies about off-balance sheet activities have shown that the generally accepted BSV are credit, interest rate, liquidity, capital, and business variables.

Focusing on mutual fund investment, Gallo, Apilado and Kolari (1996) incorporate five BSV which reflected credit, investment, capital, and business activities.[12] Analysing the market, industry, and unsystematic risk, they discovered three interesting findings: (i) not all BSV are significant to the unsystematic risk; (ii) loan expansion is negatively related to market risk; and (iii) loan expansion, investment, and mutual fund activities are inversely related to industry risk.

Looking into the effect of income structure on credit risk of European banks, Lepetit, Nys, Rous and Tarazi (2008) employed five BSV reflecting business, credit, and capital variables.[13] Studying five accounting risk measures (standard deviation of Return of Asset (ROA), standard deviation of Return of Equity (ROE), loan loss provisions to total loans, Zrisk index, and ZP-score) and three market risk measure using single-CAPM (total risk, unsystematic risk and market risk), they concluded that size is positively related to all market and accounting risk measures while capital buffer is inversely related.

With regard to the impact of foreign-owned banks on bank liquidity risk in ten European emerging economies, Dinger (2009) adopted three BSV (size, size squared, capital buffer) and four CSV (deposit rate, interbank rate, GDP growth, and per capita GDP). For the BSV, his results show that size is inversely related but capital buffer is positively related to liquidity risk.

As the theoretical grounds of risk have not yet been established, this study employs the BSV that reflect credit, capital, interest rate, liquidity, and business related variables to investigate the impact of lending structure on market risk exposure. This is done to avoid the model mis-specification errors if the relevant variables are omitted according to Gujarati (2003).

DATA AND METHODOLOGY

This model is estimated using unbalanced panel data using the generalised least squares (GLS) estimation. Gujarati (2003) found that GLS estimation helps to tackle the issue of non-normality distribution of variables, which may be caused by heteroscedasticity. Sayrs (1989) suggested that GLS corrected for errors may be used when a model exhibits autocorrelation and/or moving average errors. Wooldridge (2002) concluded that GLS is a asymptotically more efficient than Ordinary Least Square (OLS) estimations. In this study, the following three models are tested: 'pooled effect', fixed effect, and random effect model. The best model is selected based on the Likelihood Ratio and Hausman tests. To cater to the heteroskedasticity issue, this study incorporates cross-section weight in the GLS estimation. Following Shahimi (unpublished) and Zakaria (unpublished), first order autocorrelation problem is tackled based on the Park's model by incorporating AR(1) in the regression model. This study comprises of all 11 listed bank holding companies in Malaysia for 1994–2006. Data from 2007 onwards are excluded because of volatile global economy development such as the food shortage crisis, oil crisis, and the US subprime crisis, all of US which could affect the findings of this study. If these crises are taken into consideration with dummy variables, the regression analysis cannot be run due to the limited number of observations. The research design is as follows:

$$Z_{it} = \alpha_i + \beta LS_{it} + \gamma x_{it} + \delta Y_{it} + \varepsilon_{it}$$

where Z is a measure of banks' market risk, LS is a measure of lending structure, X is a vector of BSV, Y is crisis and financial consolidation dummies, α_i is an individual-specific intercept, β, γ and δ are slope coefficients to be estimated.

Market risk is estimated based on three-factor CAPM that will be discussed in the next subsection. Similarly, the lending structure variables will be discussed in detail following the market risk measure. As controlled variables, the BSV are: ratio of total loan to total asset (TL), ratio of provisions for loan loss to total asset (PLL), ratio of total equity to total asset (TE), ratio of GAP to total asset (GAP), ratio of interest expense to total asset (INTEXP), liquid asset to total asset (INV), logarithm of total asset (LTA), non-interest income to total asset (NONII) and earning asset to total asset (MGT). These variables represent loan expansion, loan quality, capital buffer, cost of fund, interest rate variable, liquid asset, size, deviation from traditional banking activities, and management efficiency, respectively. In line with the literature review, note that: (i) credit variables are TL and PLL, (ii) capital variables are TE, (iii) interest rate variables are GAP and INTEXP, (iv) liquid variable is INV, and finally (v) business-related variables are TA, NONII, and MGT. The inclusion of these variables is motivated by the works of Saunders et al. (1990), Hassan (1993), Madura et al. (1994), Gallo et al.

(1996), Angbazo (1997), Anderson and Fraser (2000), Gonzales (2004), and Ahmad and Ariff (2004). For the crisis dummies, CRISIS represents during Asian financial crisis period (1 for year 1997 & 1998, 0 otherwise) and PCRISIS represents the post crisis period (1 for 1999 onwards, 0 otherwise). For the financial consolidation dummy, PMERGER represents the post merger period (1 for post-merger period, 0 otherwise)

The expected relationship follows previous empirical finding. For TL, Hassan (1993), Madura et al. (1994), Gallo et al. (1996) suggested that loan illiquidity and default are the reasons for the positive relationship. For PLL, many studies hypothesise that loan loss provision represents the probability for future default; which is thus expected to be positively related to risk. For TE, equity is perceived to provide a buffer against loss, which is thus expected to be inversely related to risk. For GAP, a positive GAP bank (or an asset sensitive bank) is exposed to risk and interest rates will fall, and vice versa. Thus, GAP is expected to be positively related to risk. For INTEXP, Madura et al. (1994) opined that risk depends on the supply of net interest income (measured by interest expense). The higher the INTEXP, the higher the volatility of net interest income and the riskier the bank, conjecturing a positive relationship. For INV, risk is linked from the perspective of deposit withdrawals. Having idle cash is an opportunity cost to banks, which instead hold short-term investment securities to standby extraordinary deposit withdrawals. For LTA, Saunders et al. (1990), Hassan (1993) argued that bigger banks can better diversify business risk and adjust unexpected liquidity and capital shortfall, thus reducing bank risk. However, Anderson and Fraser (2000) suggested that the impact of size on risk depends on the lending structure. If the loan portfolio is the same, bigger banks should have lower risk than smaller bank. Otherwise, a bigger bank will face higher risk due to its tendency to embark into riskier lending sectors that could provide higher returns. Similarly, Gonzales (2004) posited that the existence of the economies of scale, increase market power, and the "too big to fail" policy of big banks could cause larger banks to enter risky activities either through lending strategies or off-balance sheet activities. Against this background, LTA can be positive or negative. For NONII, Madura et al. (1994) suggest diversification from the traditional role banking (lending) which can reduce risk, inferring an inverse relationship. Finally, for MGT, Angbazo (1997), Ahmad and Ariff (2003; 2004), Ahmad and Ahmad (2004) and A. Rahman, Ibrahim and Meera (in press) showed that efficiency can influence bank risk exposure. A negative association infers an efficient management. As earning assets are exposed to economic development, an inverse relationship implied that bank management is efficient. For the crisis dummies, it is expected that CRISIS has positive coefficient sign, indicating that market risk exposure is higher during a crisis period. Meanwhile, PCRISIS can be positive or negative, depending on the recovery process. Positive signs infer a

slow recovery process and vice-versa for negative sign. For the post-merger dummy PMERGER, a negative sign is expected, indicating that banks have lower market risk exposure after a merger.

Specification for Market Risk Exposure

While most studies adopt the single-factor CAPM to determine the market risk exposure of the banking sector, this study employs the three-factor CAPM. This is done for two reasons. First, the establishment of two-factor CAPM in pricing the financial institutions started in the mid-1970s; some theoretical and empirical research on the two-factor CAPM were conducted by Friend and Blume (1970), Black, Jensen and Scholes (1972), Stone (1974), Martin and Keown (1977), Chance and Lane (1980), Lynge and Zumwalt (1980), Brooth and Officer (1985), Flannery and James (1984), French and Fraser (1986), and Lloyd and Shick (1997). Second, recent studies have proposed a three-factor CAPM in pricing the financial institutions such as Chamberlain, Howe, and popper (1997) and Hahm (2004), Francis and Hunter (2004), Yong et al. (2009), and Wong, Wong and Leung (2009). Both types of studies highlight the significance of the exchange rate index as another factor on top of the two. Ignoring the effect of interest rates and foreign exchange rate movement in pricing bank stock returns would result in misinterpreting the market risk exposure *per se*, as it may capture the fluctuation of interest rate and exchange rate. Against this evolution, the yearly market risk exposure (β_m) is estimated based on the three-factor CAPM, which can be expressed as follows:

$$R_t = \alpha_j + \beta_m (R_{mt}) + \beta_i (R_{it}) + \beta_{forex} (R_{forext}) + \varepsilon_t$$

where:

R_t = return of bank during period t,
R_{mt} = daily market return (Kuala Kumpur Composite Index) from t – 1 to t,
R_{it} = daily long-term interest rate changes (Malaysian government securities 10 years) from t – 1 to t,
R_{forext} = daily foreign exchange rate (nominal effective exchange rate) changes from t – 1 to t,
β_{forex} = beta coefficient for exchange rate (exchange rate risk exposure)
ε_t = the error term which captures all other factors that affect bank return that are not taken into account explicitly.
α_j = the intercept of the characteristic line.
β_i = beta coefficient for interest rate (interest rate risk exposure)

Specification for Lending Structure Variables

Real estate lending

Several studies have attempted to investigate the impact of real estate lending on bank risk, but there is no standard definition of the real estate sector *per se*. In order to remain comparable to previous studies, this study employs three measures: (i) Real Estate (RE) lending, (ii) Broad Property Sector (BPS) lending and (iii) Risky Sector (RISKY) lending.[14]

Lending composition change (LCC)

The LCC captures the short-run stability in lending composition.[15] The LCC is computed as follows:

$$\text{LCC} = \sum_{i=1}^{12} \min(s_{it}, s_{it-1})$$

where s_{it} is the share of sector *i* in total lending in year *t*. It takes on a maximum value of 1 if there is no change in lending composition and a minimum value of 0 if the portfolio of lending by sector loan was not loaned in the previous year. Thus, a high value of LCC suggests short-run stability of lending composition.

Specialised index (SPEC)

Similar to the Herfindahl-Hirschman index, SPEC is constructed as follows:

$$\text{SPEC} = \sum_{i=1}^{12} s^2_{it}$$

where, s_i is the lending share of industry *i* in total lending. A score approaching 1 suggest a high degree of loan concentration while a score approaching 0 indicates a high degree of diversification.

Variance of traditionality index (VART)

VART measures changes in the lending composition over an intermediate term. It is a variance of traditionality index (*TI*), which is calculated using five-year intervals for each sector. The *TI* for 1995 is computed using data from 1993 to 1997; 1996, uses data from 1994 to 1998, and so on. The *TI* formula is as follows:

$$\mathrm{TI}_{it} = \frac{\Sigma_{l=-2}^{l=2} \mathrm{c}_{i,t-2}}{5}$$

where the cumulative lending experience (C_{it}) for each industry is calculated as:

$$\mathrm{C}_{it} = \frac{\Sigma_{i=t_0}^{t} \mathrm{e}_{it}}{\Sigma_{i=t_0}^{t_1} \mathrm{e}_{it}}$$

where t_0 and t_1 are initial and terminal periods of the data and e_{it} is lending of industry *i* in year *t*. Since VART is a variance of *TI* across sectors, high variance indicates an episode of divergent lending patterns during the 5-year period. Meanwhile low variance suggests stability of lending composition.

FINDINGS AND DISCUSSION

Table 1 shows the descriptive statistics of the mean, median, standard deviation, and the Jarque-Bera test of the variables employed in this study. Since most variables have significant Jarque-Bera values, mean ≠ median, we believe that most variables are not normally distributed; thus, GLS estimation is more appropriate. Table 2 presents the correlation matrix of the independent variables. Gujarati (2003) used 0.8 as the cut-off point, indicating that values larger than 0.8 are severely correlated and multicollinearity may be a serious problem if these values are included in the regression analysis. In this study, all variables have values less than 0.8, so incorporating all independent variables will not cause a multicollinearity problem.

Table 3 presents the fixed effect model, which is the best model of unbalanced panel regression estimation. The best model is based on the selection criteria of Likelihood ratio and Hausman test. The goodness of fit test (R-squared) and the standard error of regression also showed that the fixed effect model posits the highest R-squared with the lowest standard error of regression. Results in Table 3 show that the real estate lending BPS, RE, RISKY) and the specialisation (SPEC) indices are not significant; short-run lending portfolio stability (LCC) and intermediate term lending portfolio stability (VART) indicate positive associations. Our findings infer that both the increasing real estate lending and specialisation do not significantly jeopardise bank risk exposure towards stock market movements. The positive association for LCC implies that the stability of lending portfolio in the short-run increases market risk exposure. Even so, real estate lending does not significantly influence market risk exposure, and it should

Table 1
Descriptive statistics

Variables	Mnemonic	Means	Median	SD	Jarque-Bera
Risk Indicator (dependent variable)					
Market risk exposure	KLCI	1.077148	1.015178	0.458201	2.116285
Lending Structure					
Ratio of real estate sector to total loan	RE	0.291362	0.306095	0.083077	3.877345
Ratio of broad property sector to total loan	BPS	0.393711	0.410435	0.064881	1.899175
Ratio of risky sector to total loan	RISKY	0.501892	0.530872	0.079749	2.203777
Change of lending composition	LCC	0.87291	0.909363	0.085899	344.8637***
Degree of specialisation of lending	SPEC	0.157659	0.121346	0.060576	38.76333***
Variance of traditionality index	VART	0.018671	0.018266	0.012065	5.356492*
Credit related Variables					
Ratio of total loans to total asset	TL	0.520688	0.639923	0.109928	0.14812
Ratio of provision of loan loss to total asset	PLL	0.009573	0.008334	0.009084	454.9242***
Capital Related Variables					
Ratio of total equity to total asset	TE	0.085532	0.088336	0.043706	57.11536***
Interest Rate Related Variables					
Ratio of gap to total asset	GAP	–0.166462	0.176836	0.130101	4.706562*
Ratio of interest expense to total asset	INTEXP	0.031501	0.023926	0.014305	88.62623***
Liquidity Related Variable					
Ratio of short-term investment to total asset	INV	0.140777	0.120807	0.060986	2.209553
Business Operation Related Variables					
Log of total asset	LTA	7.318014	7.297271	0.383608	2.351474
Ratio of non-interest income to total asset	NONII	0.009543	0.008569	0.00654	207.2446***
Ratio of earning asset to total asset	MGT	0.852341	0.873073	0.061054	1.106941

Table 2
Correlation matrix of independent variables

	BPS	RE	RISKY	LCC	SPEC	VART	TL	PLL	TE	GAP	INTEXP	INV	LTA	NONII	MGT
BPS	1														
RE	0.819557	1													
RISKY	0.873197	0.824278	1												
LCC	0.1883	0.188159	0.115533	1											
SPEC	0.176637	–0.10528	–0.08865	–0.10374	1										
VART	0.184544	0.084414	–0.00553	0.146268	0.142321	1									
TL	–0.04098	–0.1021	0.045218	0.052245	–0.39334	0.015063	1								
PLL	–0.08574	–0.17511	–0.03548	–0.02154	–0.2888	–0.04709	0.50235	1							
TE	0.426662	0.427357	0.426743	0.12931	0.06592	0.067073	–0.07647	–0.12293	1						
GAP	0.029524	–0.15691	0.03085	–0.36439	0.088089	0.181144	0.01987	0.126974	0.013854	1					
INTEXP	–0.15495	–0.3005	–0.00477	–0.14451	–0.17303	–0.24873	0.321562	0.540047	–0.14604	0.232646	1				
INV	0.022806	–0.11702	0.017802	0.081029	–0.20544	–0.15973	0.309105	0.231604	–0.2701	–0.25521	0.230706	1			
LTA	–0.29594	0.117549	–0.29659	0.098798	–0.36712	0.104813	–0.27655	–0.18585	–0.17266	–0.32246	–0.44252	–0.05544	1		
NONII	–0.05676	–0.07491	–0.11473	–0.406	0.547939	–0.19487	–0.34228	–0.30965	0.071286	0.133744	–0.18272	–0.26071	–0.1254	1	
MGT	–0.01728	–0.31512	–0.08861	0.136698	0.32482	–0.00144	0.389851	0.189109	–0.05207	–0.18425	0.249249	0.214558	–0.4567	0.175105	1

Notes: 1. Correlation Matrix is based on common sample
2. BPS, RE, RISKY, LCC, SPEC, and VART are the alternate measures of lending structure variables.

Table 3
The GLS fixed effect model for market risk exposure

Dependent variable is market risk exposure proxied by market return of KLCI

Independent variables	Expected coefficient sign	Model 1(a)	Model 1(b)	Model 1(c)	Model 2	Model 3	Model 4
Constant		0.340342	0.58965	0.398942	–0.59244	0.330547	0.990651
		(0.369298)	(0.733899)	(0.430259)	(–0.72638)	(0.308602)	(1.256676)
BPS		0.159195					
		(0.551142)					
RE			0.32577				
			(1.125902)				
RISKY				–0.04286			
				(–0.12373)			
LCC					**0.46018****		
					(2.536842)		
SPEC						–0.08339	
						(–0.16216)	
VART							**4.60909***
							(0.788311)
TL	+	**0.58144****	**0.519347***	**0.58917****	**0.841561***	**0.58011****	–0.30844
		(2.200793)	(1.921183)	(2.215402)	(1.840782)	(2.205858)	(–0.91478)
PLL	+	0.43304	0.053072	0.908022	0.832173	0.570273	6.068525
		(0.2309)	(0.030111)	(0.40507)	(0.422985)	(0.31556)	(1.39283)
TE	–	–0.1385	–0.31971	–0.01919	–0.07278	–0.04725	–0.74949*
		(–0.41215)	(–0.9417)	(–0.05669)	(–0.19895)	(–0.15972)	(–1.83659)
GAP	+	0.279462	0.273794	0.283485	0.328248	0.285236	–0.25636
		(1.215047)	(1.257673)	(1.094739)	(1.12599)	(1.129128)	(–0.94945)
INTEXP	+	1.694665	1.995258	1.329518	3.268132*	1.432804	–1.56236
		(0.93689)	(1.119027)	(0.726191)	(1.942325)	(0.813386)	(–0.69637)

(continued)

Table 3 *(continued)*

Independent variables	Expected coefficient sign	Model 1(a)	Model 1(b)	Model 1(c)	Model 2	Model 3	Model 4
INV	–	–0.35241	–0.39495	–0.30967	**–0.66714***	–0.31636	**–1.0787*****
		(–1.1872)	(–1.3444)	(–0.93422)	(–1.7324)	(–1.20635)	(–3.7144)
LTA	±	0.126538	0.094152	0.126442	0.21049	0.135582	0.04663
		(0.943979)	(0.800088)	(0.946621)	(1.517972)	(0.820052)	(0.398076)
NONII	–	8.036844	7.819267	8.066329	**11.15108***	8.095808	**5.379166***
		(1.431908)	(1.43011)	(1.370899)	(2.362025)	(1.37221)	(1.751017)
MGT	±	**–0.7346*****	**–0.7197*****	**–0.7206*****	**–1.0164*****	**–0.7182*****	–0.06033
		(–4.04247)	(–4.10369)	(–3.9313)	(–3.87005)	(–4.08016)	(–0.09212)
CRISIS		**0.12534*****	**0.21891*****	**0.21280*****	**0.211428***	**0.12984*****	**0.56165*****
		(3.39692)	(3.51207)	(3.20428)	(3.68881)	(3.5427)	(3.22051)
PCRISIS		0.116753	0.050294	**0.12753***	**0.114242****	**0.153255***	**0.75241*****
		(1.211139)	(1.44013)	(1.67493)	(2.10673)	(1.66603)	(3.15176)
PMERGER		0.019342	0.032779	0.049252	0.042316	0.031890	0.157373
		(0.19197)	(0.326609)	(0.49352)	(0.41614)	(0.32967)	(1.10682)
Adj R^2		0.772434	0.783055	0.771153	0.824723	0.758456	0.809572
Prob (F)		0	0	0	0	0	0
D.W. statistics		2.08815	2.088019	2.086916	2.083575	2.089616	2.301058

Notes:

1. White cross-section heteroskedasticity-consistent covariance matrix estimators are reported.
2. Figures in parentheses are t-statistics.
3. ***, **, * denotes significant at 1 %, 5% and 10% confidence level, respectively.
4. Results for none effect and random effect model will be provided upon request.

be noted that a large number of non-performing loans in the BPS may aggravate the market risk exposure to an extent perhaps not fully reflected in the regression result. In June 2009, the monthly aggregate data for the Malaysian commercial banks showed that the highest non-performing loan came from the BPS, which is around 45.66% (NPL for BPS is RM14.8 million out of total NPL RM32.4 million) (*BNM Statistical Bulletin*, August 2009). Unfortunately, the data limitation at the firm level makes it impossible to test the non-performing loans in real estate lending. With regard to VART, the positive relationship infers that the instability of lending portfolio in an intermediate term period increases market risk exposure. Macroeconomic disturbances, such as the increasing real estate price and global recession may contribute to disruptions in the lending structure. To the extent that macroeconomic disturbances induce divergent lending structure patterns with increasingly financial liberalisation, the Malaysian banking sector is vulnerable to macroeconomic shocks. Thus, the sector should be more aware of domestic and external economic developments. The lending structure in the medium-term period requires a balance between the increase demand of real estate lending and market risk exposure.

With respect to the other risk determinants for market risk exposure, TL and MGT are the significant factors. Our results conform to the prior beliefs that loan expansion is positively associated with bank risk exposure. For management efficiency, the inverse association implies that increasing earning assets reduces the market risk exposure of the Malaysian banks, inferring that Malaysian banks are efficient in terms of managing their risk exposure, particularly in relation to market fluctuation.

For the crisis dummies, our finding were as expected, suggesting that market risk exposure during and after crisis periods is higher than before the 1997 Asian financial crisis. It is interesting to note that the positive coefficient sign for post-crisis period infers that the recovery process is slow. Meanwhile, for the merger effect, we find that merger and consolidation programmes introduced by the central bank of Malaysia were not really fruitful since its effect was insignificant. Thus, the policy makers as well as the practitioners should take this information into account during decision making processes.

CONCLUDING REMARKS

The impact of lending structure on market risk exposure provides some insight for policy makers, bankers and investors. For policy makers, the significant findings of LCC and VART can help to generate a proactive rather than corrective policy. However, policy makers should be caution that effects of bank lending strategies may be amplified by endogeneous changes in the sector itself.

For instance, if the government wishes to promote the agricultural sector, several incentives (such as lower funding rates or a loosened loan approvals) are given in that particular sector. Banks may change their lending portfolio composition by moving towards higher-risk lending portfolios as a reaction to bank profit erosions resulting from a low returns in the desired sector. From the perspective of bankers, the significant influence of short- and medium-term lending stability encourages them to strategise their lending portfolios according to economic cycles. Finally, for investors, knowing the determinants of market risk exposure enables them to effectively monitor their equity investments, thus helping investors to make accurate decisions.

Apart from the policy implications mentioned above, this study has some caveats that may encourage further researchs. First, other alternative market risk measures, such as the default risk premiums of subordinated debt and implied asset risks based on bank option prices, can be adopted in examining market risk exposure. However, such attempts are currently inappropriate for the Malaysian context because the Malaysia option and bond market are yet to be developed. Second, a bank's lending structure may also affect its profitability, capital structure decisions, and degrees of risk tolerance. In a broader context, the lending structure of the Malaysian banks may influence economic performance as a whole. Therefore, a bank's decision when strategising its lending portfolio should not be done in isolation, but is rather a complicated process. Therefore, studies on the relationship between lending structure and the potential interactions of those variables can be an interesting future research. Third, in terms of management efficiency measurements, we follow the measure adopted by Angbazo (1997), Ahmad and Ariff (2003; 2004), Ahmad and Ahmad (2004), and A. Rahman et al. (in press) which is the ratio of earning assets to total assets (EA/TA). More sophisticated efficiency measures, such as the Data Envelopment Approach (DEA) and the Stochastic Frontier Approach (SFA), are used to measure bank efficiency. Hence, further exploration of this aspect is urgently needed.

NOTES

[1] *Loan by sector:* (1) agriculture, hunting, forestry and fishing; (2) mining and quarrying; (3) manufacturing; (4) electricity, gas and water; (5) broad property sectors; (6) wholesale, retail trade, restaurants and hotels; (7) transport, storage and communication; (8) finance, insurance and business services; (9) purchase of securities; (10) purchase of transport vehicles; (11) consumption credit; and (12) others.

Meanwhile, *loan by economic purpose:* (1) agriculture, hunting, forestry and fishing; (2) mining and quarrying; (3) manufacturing; (4) electricity, gas and water; (5) broad property sectors; (6) wholesale, retail trade, restaurants and hotels; (7) transport, storage and

communication; (8) finance, insurance and business services; (9) purchase of securities; (10) purchase of transport vehicles; (11) consumption credit; (12) community, social, and personal services; (13) general commerce; and (14) others.

[2] In Madura et al. (1994), the deposit-taking institutions comprise the commercial banks and saving institutions. The ex-ante risk measure is implied based on call option price. They analyse nine variables that reflect credit, capital, interest rate, and business operation.

[3] With regards to the depository institutions, real estate lending and real estate owned are the determinants for the implied risk exposures. Meanwhile, the real estate owned and capital buffer are the determinants for the case of commercial banks.

[4] In Ahmad and Ariff (2003), the deposit-taking institutions comprise the commercial and merchant banks.

[5] The BSV are: NPL/TL; Lag NPL; MGT (earning asset/TA); LEV(Tier2/Total Capital); RISKY sector loan (BPS + purchase of securities + consumption credit); Regulatory Capital (Tier 1/TL); Cost of Fund; Loan loss provision; Risk Weighted Asset; KLIBOR; SPREAD; GAP; Loan/Deposit; total asset.

[6] The determinants for market risk exposure are loan quality, cost of fund, loan expansion, and lending structure. The determinants for unsystematic risk are loan quality, cost of fund, and interest rate. For total risk exposure, the unsystematic risk determinants remain significant plus additional variable, the loan expansion. Finally, the regulatory capital is the only significant determinant for equity risk.

[7] *Credit variables:* (i) loan sales, (ii) loan loss reserve, (iii) diversification index; *capital variable*: leverage; *interest rate variable*: GAP; Business variable: (i) Size; (ii) Div Payout Ratio. All except size are deflated by total asset.

[8] Please refer to Hassan (1993) for the detail explanation of the implied asset subordinated debt models.

[9] (1) *Capital variable*: book value of equity/(total asset – cash – fed funds sold-securities); (2) *Liquidity variable*: (cash + net fed fund + securities)/Total Asset; (3) *Lending structure*: (commercial + industrial loan)/Asset; and (commercial Real estate loans)/Asset.

[10] The four risk measures are: (i) σROE; (ii) σROA; (iii) σLLP./TL; and (iv) σnpl/TL.

[11] Business variables: size and non-interest income/TA; capital variable: TE/TA, Liquidity variable: liquid asset/TA; credit variable: PLL/TA and total loan/TA; Interest variable: net interest income/TA

[12] *Credit variable*: TL/TA; *Capital variable*; TA/TE; *investment variable*: Investment securities/TA; (Sales Fed fund-purchased Fed fund)/TA (-); Mutual fund asset: MFA/TA; *Business variable*: size.

[13] Business variables: (i) size; (ii) profitability differences (ROA and ROE); (iii) business differences (deposit to total asset); and (iv) personnel expenses to total assets. Credit variable is total loan to total asset, and capital variable is total equity to total asset.

[14] Madura et al. (1994) and Blasko and Sinkey Jr (2006) focus on loan given specific to real estate sector (RE), which comprise of residential, non-residential properties, and real estate. In Malaysia, broad property sector (BPS) comprises of RE and construction sector. Roza Hazli (2007) employs BPS as a proxy for real estate lending. Meanwhile, Ahmad and Ariff (2003; 2004) and Ahmad and Ahmad (2004) employ RISKY sector lending. Their RISKY sector comprises of loan given to BPS, purchase of securities and consumption credit. All measures are ratios to total loan.

[15] Twelve sectors are employed to construct lending indices representing characteristics of bank lending compositions. The 12 sectors are agriculture, hunting, forestry and fishing; mining and quarrying; manufacturing; electricity, gas and water; broad property sectors; wholesale, retail trade, restaurants and hotels; transport, storage and communication; finance, insurance and business services; purchase of securities; purchase of transport vehicles; consumption credit; and others.

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